REMARKS/ARGUMENTS

Claims 1–14, 21 and 23–27 are pending. The claims remain unchanged.

The invention as defined by the claims of the application is (a) an insulation product composed of mineral fibers comprising the polycarboxylic acid and polyamine as the sizing composition on those fibers; and/or (b) a method of manufacturing an insulation product comprising applying a sizing composition of polycarboxylic acid and polyamine to mineral fibers and treating that under conditions (e.g., heat) to cure the sizing composition on the mineral fibers.

The Examiner has raised a series of new rejections based primarily on U.S. 5,437,928 to Thimons. More specifically, claims 1-4, 6-12, 14, 21, 24-25, 27 were rejected under 35 USC 102(b) citing only Thimons; claim 5 was rejected under 35 USC 103(a) citing Thimons and Nigam; Claim 13 was rejected under 35 USC 103(a) citing Thimons alone; Claim 23 was rejected under 35 USC 103(a) citing Thimons with Drummond; and Claim 25 was rejected under 35 USC 103(a) citing Thimons alone.

Thus, a central question pertinent to all of the rejections is whether Thimons describes or reasonably suggests an insulation product composed of mineral fibers comprising the polycarboxylic acid and polyamine as the sizing composition on those fibers. Thimons does not describe an insulation product but rather a glass fiber mat specially constructed for reinforced composites and laminates.

Thimons is cited because it teaches a size applied to fibers that can include carboxylic acid and polyamine, among other components. See, e.g., col. 5, lines 40-50 and Table 1 (Example 1) in col. 7 relating to the subject matter of Claims 1-4, 6-12, 14, 21, 24-25 and 27 (Official Action at pages 2-3).

While Applicants understand that, during the prosecution of an application in the Office, claims are to be given their broadest reasonable interpretation consistent with the

teaching in the specification (*In re Bond*, 710 F.2d 831, 833 (Fed. Cir. 1990)), it is error to disregard express limitations in the claims. The Examiner may not set up a "strawman" claim and reject it rather than subject matter encompassed by the actual claims.

The plain language of Applicants' claims requires "thermal and/or acoustic insulation product" (cf Claim 1).

Thermal and/or acoustic insulation products comprising mineral fibers are manufactured by the well known technique of external or internal centrifugal fiberization. This technique is illustrated in Fig. 13.5 for mineral fibers such as rock wool (external centrifugal fiberization) and in Fig. 13.6 for glass fibers (internal centrifugal fiberization) of the attached document entitled "Phenolic Resins; A. Knop and LA Pilato; Ed. Springer-Verlag; p. 215–216; 1985.

In particular, the internal centrifugation involves introducing the molten material (glass) into spinner(s) having a multitude of, small holes, the material being thrown against the peripheral wall of the device in the form of filaments varying in length. At the exit of the device, the filaments are attenuated and entrained by a high-temperature high-velocity gas stream toward a receiving member (conveyor) in order to form a web of randomly distributed fibers (p. 1, I. 21–33 of the English translation of the PCT application provided to you on October 14, 2005).

To ensure mutual assembly of the fibers, the fibers leaving the spinner(s) are sprayed with a sizing composition (resin sprays) containing a thermosetting resin and then the web of sized fibers is heat-treated in order to crosslink the resin (p. 2, I. 1–7).

The final product is an insulation product composed of fibers bonded together by junctions points that are sufficiently strong to ensure good adhesion and to ensure that the product does not tear when used (p. 2, I. 15–18). The junctions between the fibers provide a network that is stable and rigid enough to withstand the compression imposed by storing and

transporting the product, ,and meets the supplier's specifications when the product is being made (p. 2, I. 21–26), that is to say after being unfolded or unrolled.

While Applicants understand that in some instances a preamble phrase is not considered as a limitation when it simply states a purpose or intended use (MPEP 2111.02), in the present case the phrase thermal and/or acoustic insulation product defines the structure of the product because that phrase does give specific meaning to what the claims are and what they are not. Indeed, as explained in detail above referencing the attached publications, a thermal and/or acoustic insulation product has specific structure that delineates it from other materials.

Guidance on the discussion for preambular phrasing is found in MPEP 2111.02: "If the claim preamble, when read in the context of the entire claim, recites limitations of the claim, or, if the claim preamble is 'necessary to give life, meaning, and vitality' to the claim, then the claim preamble should be construed as if in the balance of the claim." *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305, 51 USPQ2d 1161, 1165-66 (Fed. Cir. 1999). Any terminology in the preamble that limits the structure of the claimed invention must be treated as a claim limitation. See, e.g., *Corning Glass Works v. Sumitomo Elec. U.S.A., Inc.*, 868 F.2d 1251, 1257, 9 USPQ2d 1962, 1966 (Fed. Cir. 1989).

Applicants submit that the Examiner erred in broadly interpreting the scope and content of the subject matter claimed in a manner inconsistent with the plain language of the claims and the teaching of the Specification, particularly in not giving the required due consideration to the fact that the claims are to a thermal and/or acoustic insulation product.

Thus, the product that is defined in the claims is different, in terms of its structure, when compared to Thimons.

Thimons et al. (US 6 437 926), disclose an aqueous size composition for glass fibers, and the use of said glass fibers to form a mat suitable for use as reinforcement for thermoplastic polymers (col. 1, I. 4–6).

Mats for the reinforcement of thermoplastic polymers provide reinforced composites and laminates of excellent strength, which have good flow and other properties when molded or shaped 'into various articles (col. 1, I. 63–67).

Thimons et al. disclose that the mat is obtained from glass fibers onto which the size composition is applied by any method known to those skilled in the art (col. 6, I. 62–64). The application of the size composition to the fiber normally results in strands or fibers.

The conventional method used for the manufacture of strands of fibers is illustrated in Fig. 111/11 of the attached The Manufacturing Technology of Continuous Glass Fibers; K.L. Loewenstein; Ed. Elsevier; p. 27–29; 1983.

Molten glass exudes from nozzles located on the underside of a bushing. The glass issued from each nozzle is drawn into a fiber and the whole fan of individual fibers (called filaments) passes through a light water spray and then over a fiber site applicator which transfers the size onto the filaments before they are gathered into a bundle; of filaments called strands. From there, the strand passes to the attenuation machine, i.e. a winder consisting of a slightly expandable rotating cylinder, called collet, covered with a removable tube on which the strand is wound (p. 28, § 2 – 3). The package of strand, called cake, is dried and after is ready to be converted into saleable products (p. 29, § 1).

Said saleable products include chopped strand, continuous strand or roving, milled strand or mats, in particular needled continuous strand or mats, as disclosed by Thimons et al. (col. 6, I. 3-10).

All the examples given by Thimons et al. use a needled continuous strand mat which is combined with a polypropylene film and pressed to obtain a laminate.

Clearly, the mat of Thimons et al. is not a thermal and/or acoustic insulator product as claimed in present Claim 1.

One having skilled in the art of the manufacture of insulation products would not have considered Thimons et al. because it refers to reinforcing mats for polymer which belongs to a technical field which is far from that of the present invention.

As should now be apparent, the chemical composition and role of the sizing composition, the process for the manufacture of fibers and the mat made from the fibers are very different.

Therefore, Claims 1–14, 21 and 23–27 cannot be anticipated by nor obvious in view of Thimons et al.

The addition or Nigam (to reject Claim 5) or Drummond (to reject Claim 23) to Thimons does not resolve the fundamental differences between the product defined in the present claims and the very different product taught by Thimons.

Indeed, just like Thimons, Drummond discloses one method used to manufacture of needled continuous strand mats (col. 6, I. 61). Drummond discloses that the needled mat may be obtained from continuous glass strands either formed from molten glass flowing from a bushing as explained above (Fig. 1, right part) or coming from packages (Fig. 4, left part).

Reconsideration and withdrawal of all of the outstanding rejections is requested.

Also, a Notice of Allowance is requested.

Respectfully submitted,

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A. Knop, L. A. Pilato

Phenolic Resins

Chemistry,
Applications and Performance

Future Directions

With 109 Figures and 114 Tables

Dr. Andre Knop
Rütgerswerke AG, Frankfurt, FRG

Dr. Louis A. Pilato
Temecon Group International Inc., Bound Brook, NJ, USA

With participation of Volker Böhmer (Chapter 4)

This volume continues the monograph "Chemistry and Application of Phenolic Resins" by A. Knop and W. Scheib

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Preface

In 1983/84 American Chemical Society, N.Y., Kammer der Technik, Berlin/GDR, and chemical companies closely associated with phenolic resins underscored the embryonic efforts of Leo H. Baekeland and celebrated the 75th anniversary of the first wholly synthetic plastic material during symposia held in Washington, D.C., August 1983, and Berlin, September 1984, respectively.

Since their introduction in 1910, the highly versatile family of phenolic resins has demonstrated an important role in the continuing development of the electrical, automotive, construction and appliance industries. In the 80's the wave of high technology has fostered their active participation in "high tech" areas ranging from electronics, computers, communication, outer space/aerospace, biomaterials, biotechnology and advanced composites. Many phenolic resin systems are actively involved in the "leading edge" of these innovative technologies. Thus, they demonstrate an uncanny versatility to be adaptable to prevailing times as today's society is transforming from an industrial to an information/communication society.

The excellent participation at the recent scientific symposia and the acceptance of the early edition "Chemistry and Application of Phenolic Resins" by A. Knop and W. Scheib – including the Japanese and Russian translation – by the industrial and chemical community demonstrated a high level of interest in the broad subject of phenolic resins and has provided the stimuli of this present publication.

This volume covers fundamentals, the chemical and technological progress, and new applications including the literature generally up to July 1984. Special emphasis was assigned to advanced instrumental and analytical techniques and environmental aspects.

We would like to express our gratitude to all colleagues engaged in the phenolic discipline, in particular to those who have assisted us with advice and suggestions.

Frankfurt and Bound Brook, July 1985

A. Knop
L. Pilato

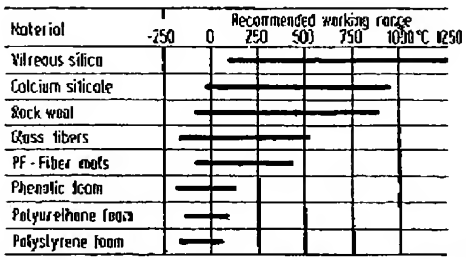

Fig. 13.2. Temperature range of application for some insulating materials[2]

Fig. 13.3. Heat insulation of buildings with mineral fiber mats. (Photo: Deutsche Rockwool Mineralwoll GmbH, D-4390 Gladbeck)

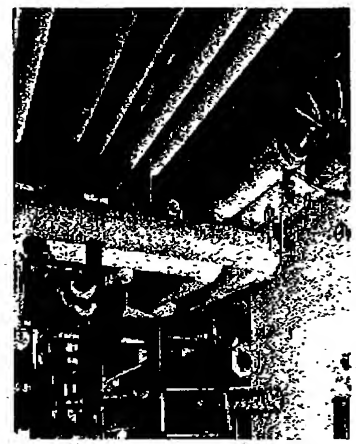

Fig. 13.4. Heat insulation of pipe lines with mineral fiber shells (Photo: Grünzweig & Hartmann und Glasfaser AG, D-6700 Ludwigshafen)

The flame retardancy, low smoke density of phenolic resins and different national standards and ratings are mentioned in the phenolic foam section and Chap. 6.5. Phenolic resin bound fiber composites possess an attractive upper temperature range as compared to organic cellular plastics (Fig. 13.2).

Fibrous insulation is applied to blankets and felts with a density of 10–250 kg/m^3 and can be clad on one side with bitumenous membranes or quilted on both sides. The blankets can also be clad with plastic or aluminium foil which acts as a vapour barrier. Water vapor permeation, which increases the conductivity, is a serious problem in the low temperature range. Blankets for insulation of pipes and containers can be reinforced with wire mesh. One piece pipe insulation is produced for pipes of 20–900 mm diameter.

The blankets may be installed around the house, on exterior walls, basement masonry, floor, partitions and roof. Apart from heat insulation, good sound insulation is also desired.

Table 13.1. Chemical composition of mineral fibers[5]. (x = including also 5–12% iron oxide)

	SiO_2	Al_2O_3	CaO	MgO	B_2O_3	$Na_2O + K_2O$
Glass fiber	50–65	3–15	5–15	2–5	1–12	1–18
Slag fiber	30–35	10–20	40–45	2–8	–	–
Stone fiber^x	50–55	6–15	25–35	2–6	–	2–3
Basalt fiber^x	45–50	12–15	9–12	7–10	–	2–4

Prefabricated shells are used to insulate pipe lines for hot water, steam or oil etc., or in the form of blankets for industrial furnaces, reactors and containers. The limit of application is up to 450 °C. Although the binder is slowly degraded at temperatures above 250 °C, the performance of the insulation is not affected. Cold insulation includes refrigeration equipment for the storage of foodstuffs, gas liquefication plants, house-hold appliances, refrigerated cars, ships etc. Glass wool is mainly used in the lower temperature region and for domestic purposes, while mineral wool is proposed in areas of higher temperatures and for industrial application[4]. As far as the quantity (volume) is concerned, glass fiber insulation volume is greater than mineral wool. The market share of slag fibers is relatively small and decreasing.

13.1.1 Inorganic Fibers and Fiber Production

Mineral fibers are multi-component systems with the main components (Table 13.1) being SiO_2, Al_2O_3, CaO, MgO with mean eutectic points at 1,170, 1,220 and 1,345 °C[5]. The chemical composition of the melt determines the thermal resistance, the devitrification temperature and devitrification rate.

Mineral wool production process is shown in Fig. 13.5. Basalt on diabase rocks is melted by the addition of lime and foundry coke at approx. 1,500 °C in a cupola furnace. The higher the content of silica, the "longer" the melt performance. The upper limit of SiO_2 content is determined by the increased melting and spinning temperature[6].

The molten material then flows to four rotating spinning wheels (3,000–5,000 rpm) and is spun into thin fibers with diameters of between 3–7 µm by centrifugal force. The formulated phenol resin is added as bonding agent in the blowing chamber along with oil (~0.2%) to make the wool dust-free and water-repellent[7].

The melt yield is within the range of 70% calculated on the rock amount. The resulting material may contain at least 40% of non-fibrous material generally in the form of small pellets, called shot, depending upon the method of production and chemical composition. The overall fiber yield can be as low as 40%.

High-silica glass fibers[8], on the other hand, are almost shotfree (0.1%). The absence of shots frequently justifies the higher material costs because of the higher effectiveness in relation to weight. The production of glass fiber insulation materials is shown in Fig. 13.6 and is analogous to mineral fiber.

In collecting chambers, the fibers are drawn onto a conveyor belt to build up a mat of desired thickness and density. Then the wool is passed through an oven in which the phenol resin is completely cured. Several additional processes follow, such as cutting to size, shape forming, controlling and packaging.

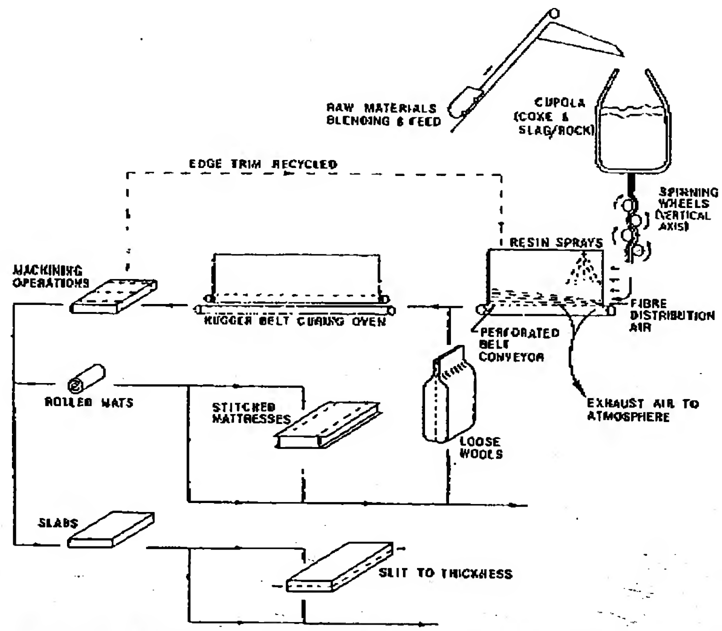

Fig. 13.5. Mineral fiber production process. (Drawing: Newalls Insulation Co. Ltd., Washington, GB)

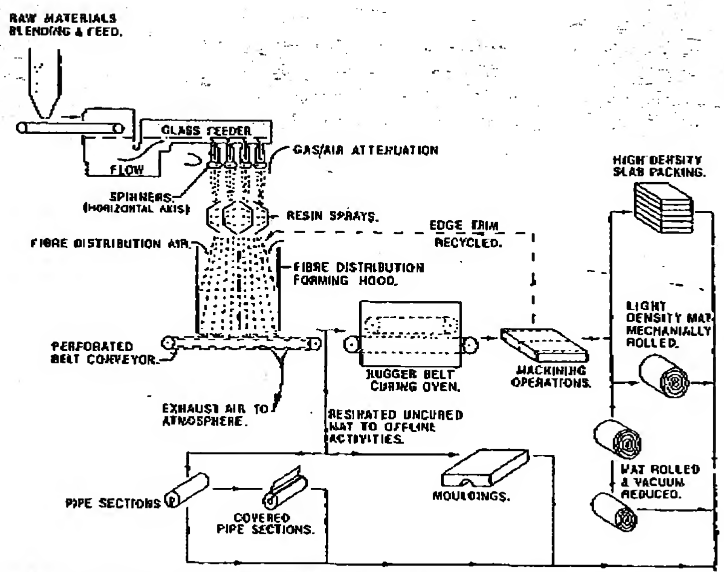

Fig. 13.6. Glass fiber production process. (Drawing: Newalls Insulation Co. Ltd., Washington, GB)

13.1.2 Resins and Formulation

Generally, an aqueous resol solution is sprayed onto a mass of hot fibers and then the mass is further heated until the resin is wholly cured. Since the highly diluted resol is spread around the fibers in form of extremely small drops and is subjected to relatively high temperatures of 200 °C and higher, a significant amount of low molecular weight resol components, mainly phenol, formaldehyde and saligenin, are volatilized. Because of this the economics of production are adversely affected. The emission of phenols and formaldehyde creates an environmental problem. Due to the huge amounts of air required in the blowing chamber and therefore low concentration of combustible substances, the treatment of the exhaust air has not yet been satisfactorily resolved.

The application efficiency of a resin binder solution is determined by the following:

$$E = \frac{W}{G \cdot V \cdot S} \times 100\ (\%)$$

E figures for efficiency, W for the increase in weight of the fibrous mass after curing, G for the specific gravity of the binder solution, V for the volume of resin used and S for the percentage of solids in the resin as evaluated by standard methods. The achievable resin efficiency in large commercial plants today is within the range of 60–80%.

Appropriate resol resins are obtained by reacting phenol with an excess of formaldehyde at temperatures below 70 °C. The PF ratio is between 2.5 and 3.5. The remaining free formaldehyde up to 7% (Table 13.2) is used to bind urea. Not only does urea react with formaldehyde but it has also been shown[9] to undergo a co-condensation reaction with methylol phenols (Chap. 3.8). In general, alkaline earth hydroxides e.g. calcium or barium hydroxide, seldom sodium hydroxide, are used as catalysts. High-quality resins are normally ash-free, the catalyst is precipitated as sulfate or carbonate and removed by filtration. A high formaldehyde ratio favours high resin efficiency. Urea is added in most formulations up to 40% (calculated on dry weight) to reduce cost.

The resin is applied as a 10 to 15% aqueous solution; a high water dilutability is an important requirement. A satisfactory resin consists mainly of mono-nuclear polymethylolated compounds, the prevailing species being trimethylolphenol (Fig. 7.4). The amount of polynuclear compounds should be as low as possible. The effect of storage caused by condensation reactions is shown in Fig. 13.7. The effect of pH on the

Table 13.2. Phenol resol properties for the production of mineral- and glass fiber mats[11] (Fig. 7.4)

Dry solids content	%	40–50
pH	–	7.0
Viscosity at 20 °C	mPa·s	8–20
B-time at 130 °C	min	8–10
Dilutability with water	ratio	1:10
Content of free phenol	%	< 1.0
Content of free formaldehyde	%	1–7
Storage life at 20 °C	days	14
Storage life at 10 °C	days	35

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Glass Science and Technology 6

The Manufacturin Technology of Continuous Glass Fibres

(Second, completely revised edition)

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PREFACE to the Second Edition

This book deals with continuous glass fibres used, in the mai for reinforcing plastics, rubber and bitumen, and for fireproof curtains. These fibres are not necessarily long or continuous w used in such applications but, when first manufactured, are draw as continuous fibres from the molten glass.

This differentiates them from discontinuous, short, or staple fibres - commonly referred to as glass wool - which are almost e tirely used for heat and sound insulation. Although some aspect of the manufacturing technology are similar to that for continuc fibres, the fiberisation process is different since it aims at making intertwined, short, bent lengths of glass fibre.

The technologies and markets for the two types of glass fibre thus differ sufficiently that they require separate treatment. further reference to glass fibres in this book will therefore ir glass fibres of the continuous kind.

Historically, the glass fibre industry is part of the plastic and textile industries. In addition to these, it is now firmly tablished also in the building components and transportation inc tries. Glass fibre is a raw material for reinforcing organic pc mers and, sometimes, inorganic materials such as concrete, and which the general public encounters in the form of boats, parts aircraft, car components and vehicle bodies, translucent roofing sheet and cladding, bitumenous roofing sheet or felt, roofing t. (shingles in North America), foamed PVC flooring, car tyres, sea in public buildings, buses, etc. One of the biggest uses is in logic and printed circuit cards. As part of the textile indust proper, woven glass fibre curtain materials have established a ket, mainly for use in public buildings because of their fire r istance.

Technologically, the manufacture of glass fibres is part of glass industry, but such has been the secrecy and exclusivenes of this new industry that most glass technologists have never s the process, and other technicians from outside - and sometimes side - the industry have very often seen only small sections of whole on the principle of "the need to know".

The first edition, prepared 10 years ago, made a start in pr

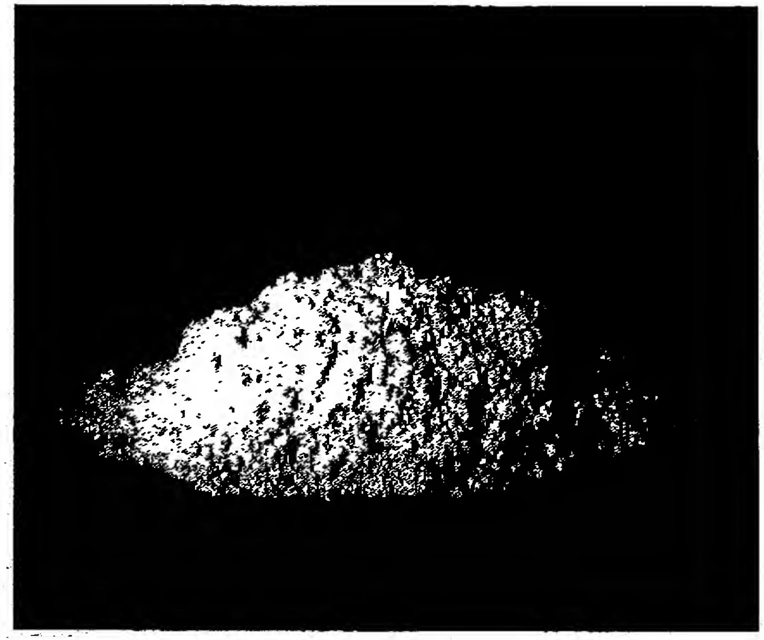

Fig.III/9. Milled fibres. (Courtesy of TBA Industrial Products Ltd., U.K.)

nto saleable glass fibre products.

At one time these three stages always constituted separate manu-acturing activities, even if they were located in the same plant. ome 25 years ago stages 1 and 2 were integrated into one continu-us process for products which were required in sufficiently large uantities; it was called the "direct-melt" process as the molten lass made at stage 1 is directly converted into fibre.

Continuous filament mat, surfacing tissue and overlay mat were lways made directly during the fibre-drawing process and they, herefore, constitute integration of process stages 2 and 3. It s very likely, if it has not happened already, that continuous ilament mat is made directly as part of a direct-melt process; here is no theoretical reason against it. It is only a question f the quantities of continuous filament mat required.

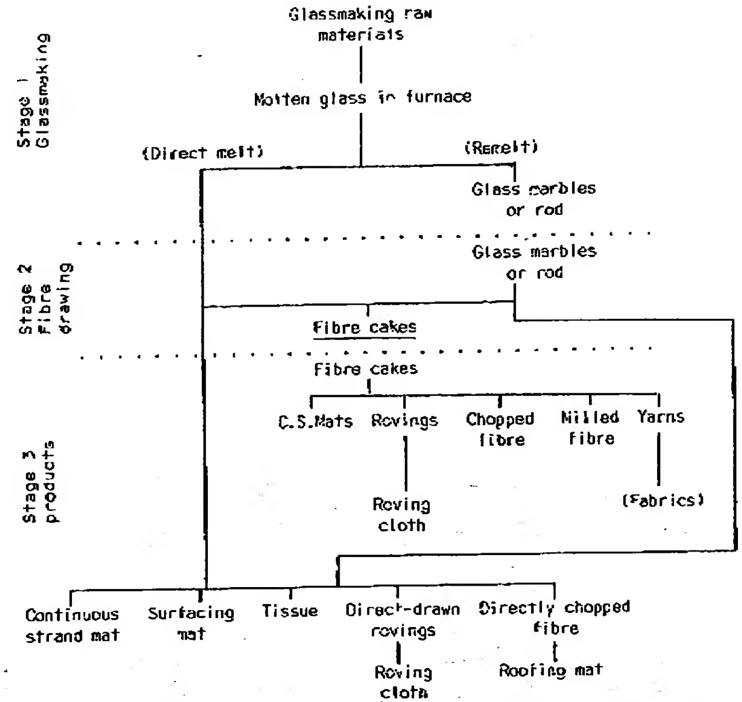

Fig.III/10. Summary of glass fibre manufacturing methods. There is no theoretical reason why the products in the last group (continuous strand mat, etc.) cannot be produced by either the direct-melt or the remelt processes. However, the author is not aware that any significant quantity of direct-drawn rovings are made other than by the direct-melt process.

More recently substantial quantities of a new type of roving suitable for weaving and winding have been made in one continuous process combining stages 1, 2 and 3 (see Section V.6.2. and VII.3.4.).

In the last decade, the manufacture of roofing mat using glass fibre as reinforcement has led to the development of machines which attenuate the glass into fibres and immediately chop them into short lengths, e.g. 12 mm, for transfer to the roofing mat machine (see Section VII.3.). This could also be considered to be an integration of stages 1, 2 & 3.

Stage 1 consists of glass manufacture, i.e. the fusion of selec-ted, weighed and mixed raw materials such as sand, limestone, boric acid etc. in a glass-making furnace. This stage concludes either

with liquid glass flowing directly to the fibre-drawing furnaces called "bushings" (i.e. the direct-melt process), or the glass being made into marbles or rod, annealed and cooled to room temperature, and stored in clean containers ready for use in the remelt process at some future date.

Stage 2 consists of fibre drawing. Continuous glass fibres are made by the rapid mechanical attenuation of molten drops of glass exuding from nozzles located on the underside of an electrically heated furnace, called a bushing. A bushing is provided with a large number of nozzles, usually 200 or a multiple thereof, and is supplied with glass either in the form of cold marbles which first have to melt before the liquid glass can pass through the nozzles, or with liquid glass directly from a glass-melting furnace.

The fiberising process is shown diagrammatically in Fig.III/11. Molten glass exudes from each nozzle where, during fibre drawing, the glass forms a meniscus as a result of the attenuation. The whole fan of individual fibres, called filaments, passes through a light water spray and then over an applicator which transfers a protecting and lubricating size onto the filaments before they are gathered on a suitably-shaped shoe into a bundle of filaments called a strand or, if desired, a number of smaller strands. From there the strand passes to the machine responsible for the attenuation, i.e. the winder. This consists of a slightly expandable rotating cylinder, called a collet, covered during the winding process by a removable paper or plastic tube onto which the strand is wound, and a device which lays successive lengths of strands onto the tube at small angles to one another to facilitate subsequent unwinding.

Various names have been used for this device, e.g. traverse, beater, waywinder, spiral, etc. The term traverse will be used here. The thickness of fibre strand being wound onto a collet is allowed to reach about 25 - 30 mm before the collet is stopped and the package of strand, now called a cake, is removed; the winding operation is then recommenced.

Each group of equipment as shown in Fig.III/11, consisting of a bushing and its electric supply, fibre size applicator, gathering shoe, water sprays, and winder, constitutes a production unit. In a fibre-drawing department several of these, sometimes several hundred, are placed together, usually in lines, each bushing at a distance of between 600 and 900 mm from the next.

The cake, having been coated with a fibre size, is wet and requires drying before further processing. After drying and conditioning the fibre cakes are ready to be converted into saleable products.

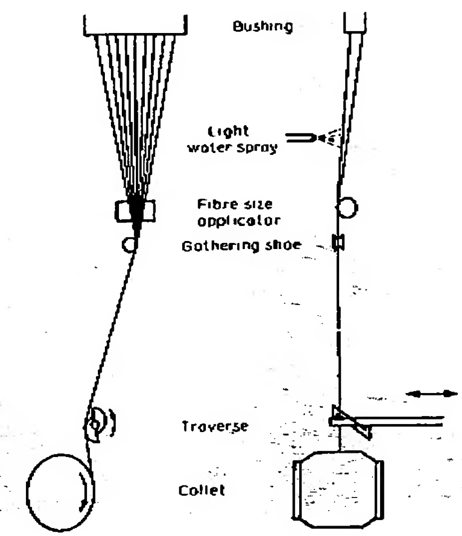

Fig.III/11. Diagrammatic representation of the manufacturing process of continuous glass fibres. The above scheme is the most typical, but there are variations.

Glass fibre strands manufactured at this stage are defined in terms of fineness of individual fibres and the weight per unit length (or its inverse). These, by implication, also involve th number of filaments per strand. Since the system originated in the U.S.A. it was developed using American units. Each strand i defined by a letter which denotes the average diameter of the Fi ments constituting the strand, and a number which denotes the "count". The count is defined by the number of hundred yards pe pound (454 g). The metric equivalent is Tex, defined as grammes per kilometer. Count and tex are related by the equation:

Count x Tex = 4961

The more commonly produced filament diameters are given in Table III/1.